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25) A method for use in calculation of a swept volume of a computer generated model of a real-world object, the method comprising:

generating a three dimensional polyhedral representation of the model of the real-world object, the representation comprising a plurality of polygons joined at their edges;

representing three dimensional motion of the modeled object by a series of sequential positions of the modeled object in three dimensional space; and

for each position in the series of sequential positions of the modeled object,

determining a subset of the edges such that each edge in said subset has a trajectory through a corresponding ~~free neighborhood~~ first zone in which motion of the corresponding edge comprises motion on the boundary of the modeled swept volume during motion of the modeled object from a current position to a next position ~~and~~ where each such edge's corresponding ~~free neighborhood~~first zone comprising a ~~tangent zone comprising a~~ region external to the material of the modeled object and bounded by a planar extension of the polygons that join at said edge,

determining a subset of the polygons such that each polygon in said subset has a trajectory through a corresponding second zone during motion of the modeled object from a preceding position to a current position and from the current position to a next position where each such polygon's second zone comprises a zone represented by a half sphere, said half sphere comprising a flat face that is planar with said polygon and said half sphere extending interior to the modeled object, and

generating a trace of the motion of said subset of edges between said current and said next positions~~;~~ and

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constructing a representation of the swept volume from the generated traces of the motion of said subset of edges wherein constructing a representation of the swept volume further comprises bounding the swept volume at each of said current positions in said series by said subset of polygons associated with each such current position.

27) The method of claim ~~26~~ 25 wherein each of said plurality of polygons is a triangle.

30) The motion of claim ~~26~~ 25 wherein the representation of sequential positions of motion comprise rotational and translational representations.

31) A computer system for use in computing ~~controlling generation of a~~ swept volume for a model of a real-world object, the system comprising:

a processor operatively interconnected to a memory;

a user input device;

a display; and

a graphical user interface responsive to activation with the user input device by causing a program stored in the memory to be executed by the processor, said program configuring the processor to perform computations whereby:

a three dimensional polyhedral representation of a computer model of a real-world object is generated, the representation comprising a plurality of polygons joined at their edges,

three dimensional motion of the modeled object is represented with a set of position matrices,

for each of a series of sequential positions of the modeled object as represented by the matrices,

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a subset of the edges is determined such that each edge in said subset has a trajectory through a corresponding first zone in which motion of the corresponding edge comprises motion on the boundary of the modeled swept volume~~free neighborhood~~ during motion of the modeled object from a current position to a next position and where each such edge's corresponding ~~free neighborhood comprising a tangent zone comprising~~ first zone comprises a region external to the material of the modeled object and bounded by a planar extension of the polygons that join at said edge,

a subset of the polygons is determined such that each polygon in said subset has a trajectory through a corresponding second zone during motion of the modeled object from a preceding position to a current position and from the current position to a next position and where each such polygon's second zone comprises a zone represented by a half sphere, said half sphere comprising a flat face that is planar with said polygon and said half sphere extending interior to the modeled object, and

traces are generated by the motion of the subset of edges during motion between a current and a next position, and

a representation of the swept volume is constructed from the traces of the subset of edges ~~,~~ and bounded at each of said current positions in said series by said subset of polygons associated with each such current position.

33) The computer system of claim ~~32~~ 31 wherein the position matrices representing motion comprise motion data associated with a real-world object that is collected during physical experiments.

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34) The computer system of claim ~~32~~ 31 wherein each of said plurality of polygons is a triangle.

35) A computer program residing on a computer-readable medium, the program comprising instructions for causing the computer to:

generate a three dimensional polyhedral representation of a computer model of a real-world object, the representation comprising a plurality of polygons joined at their edges;~~,~~

represent three dimensional motion of the modeled object with a set of position matrices;~~,~~

for each of a series of sequential positions of the modeled object as represented by the matrices;~~,~~

determine a subset of the edges such that each edge in said subset has a trajectory through a corresponding ~~free neighborhood~~ first zone in which motion of the corresponding edge comprises motion on the boundary of the modeled swept volume during motion of the modeled object from a current position to a next position and where each such edge's corresponding ~~free neighborhood~~first zone comprising ~~a tangent zone comprising~~ a region external to the material of the modeled object and bounded by a planar extension of the polygons that join at said edge,

determining a subset of the polygons such that each polygon in said subset has a trajectory through a corresponding second zone during motion of the modeled object from a preceding position to a current position and from the current position to a next position and where each such polygon's second zone comprises a zone represented by a half sphere, said half sphere comprising a flat face that is planar

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with said polygon and said half sphere extending interior to the modeled object, and

generate traces of the motion of the subset of edges during motion between a current and a next position~~,~~; and

construct a representation of the swept volume from the traces of the subset of edges and bounded at each of said current positions in said series by said subset of polygons associated with each such current position.

36) A method for use in calculation of a swept volume of a computer generated model of a real-world object, the method comprising:

generating a two dimensional representation of the model of the real-world object, the representation comprising a plurality of edges joined at vertices;

representing two dimensional motion of the modeled object by a series of sequential positions of the modeled object in two dimensional space; and

for each position in the series of sequential positions of the modeled object,

determining a subset of the vertices such that each vertex in said subset has a trajectory through a corresponding ~~free neighborhood~~ first zone in which motion of the corresponding edge comprises motion on the boundary of the modeled swept volume during motion of the modeled object from a current position to a next position and where each such edge's corresponding ~~free neighborhood~~first zone comprising ~~a tangent zone comprising~~ a region external to the material of the modeled object and bounded by a planar extension of the edges that join at said vertex,

determining a subset of the edges such that each edge in said subset has a trajectory through a corresponding second zone during motion of the modeled object from a preceding position to a current position and from the current position to a next position and where each such polygon's

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second zone comprises a material zone represented by a half circle, said half circle comprising a flat face that is aligned along said edge and said half circle extending interior to the modeled object, and

generating a trace of the motion of said subset of vertices between said current and said next positions, and

constructing a representation of the swept volume from the generated traces of the motion of said subset of vertices and edges.

REMARKS

Applicant's remarks, below, are preceded by related comments of the Examiner, presented in small bold-faced type.

Claim Rejections - 35 USC § 112

5. Claims 29 and 39 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 29 and 39 state "each free neighborhood comprises an area in which motion of the corresponding entity comprises motion on the boundary of the modeled swept volume". This is new material added in the amendment and not found in the original specification.

Applicant has amended all claims in the application to remove the term "free neighborhood." Applicant believes that this term is unnecessary and, though intended to provide clarity, has resulted in confusion throughout the application process. In place of the term "free neighborhood" applicant has substituted the term "zone"", or a substantially similar phrase ("first zone", "second zone").

Applicant notes that the term "zone" is used in its ordinary sense and is further limited by specific claim recitations defining essential features of the referenced "zone."

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Applicant respectfully disagrees that the claim recitation "each free neighborhood [as amended, a "zone"] comprises an area in which motion of the corresponding entity comprises motion on the boundary of the modeled swept volume" is new material added in the amendment and not found in the original specification. In contrast to the Examiner's suggestion, originally filed Figs. 5-10 are sufficient disclosure to support this claim recitation.

In any case, the disclosure of this claim phrase by Figs. 5-10 is further supported by text of the original disclosure. For example, descriptive text at page 6 of the original specification recites that "A boundary of the swept volume can generally be modeled by determining for each time t a subset of points belonging to the boundary of the moving object and sliding along the boundary of the swept volume."

Further examples and additional details of regarding support the disputed claim recitation is as follows:

- Fig. 5, area labeled "Free Neighborhood (Material zone) of an edge" (510) together with Figs. 6-9 showing that an edge along the material zone of Fig. 5 is computed as being on the boundary of the computed swept volume 910. See also, descriptive text corresponding to Figs. 5-9.

- On page 6, text beginning "To represent a swept volume" and concluding "material of the object modeled."

- On page 7, text stating "The free neighborhood of an edge can be represented by two portions of a sphere delimited by planes of the adjacent triangle.

- Fig. 10 and text on page 7 stating "a test can determine if the current edge is moving in a tangent zone 1017. If a current edge is moving in a tangent zone, the program can compute a trace generated by the edge 1018." Applicant further notes that the term "tangent zone" is described in the original specification as one type of "zone in which motion of the corresponding edge comprises motion on the boundary of the modeled swept volume."

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6. Claims 25-39 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

6.1 These claims are rejected because they use the concept of free neighborhood directly or as claims dependent on independent claims that use the concept of free neighborhood. However, the specification does not contain the definition of the free neighborhood anywhere, making it impossible to one of ordinary skill in the art to understand what the applicants mean by that term. Such a definition is found only in the amendment filed on February 6, 2002 on Page 13.

The claims have been amended to remove the term "free neighborhood" as further explained, above, with respect to paragraph 5 of the Office Action and, as explained above, sufficient disclosure is provided to support this term.

6.2 Claims 25, 31 and 35 refer to the edge's free neighborhood comprising a tangent zone comprising a region external to the material of the modeled object and bounded by a planer extension of the polygons that join at said edge. Claim 36 refers to the edge's free neighborhood comprising a tangent zone comprising a region external to the material of the modeled object and bounded by a planer extension of the edges that join at said vertex. The definition used for the edge's free neighborhood in Claim 36 appears to be in error and conflicts with the definition used in Claims 25, 31. and 35. Should this be a vortex's free neighborhood? These definitions conflict with specification Page 2, Para 3, "Free neighborhood is represented by angular portions for various entities forming boundary of the polygon"; specification Page 7, Para 3, "Free neighborhood of an edge is a tangent zone, represented by two portions of a sphere, delimited by planes of adjacent triangles".

The Examiner's questions are believed to be moot in light of the removal of the terms "free neighborhood" and "tangent zone" from the claims. The claims now recite appropriate clarifying language.

6.3 Claims 26 and 32 refer to the polygon's free neighborhood comprising a material zone represented by a half sphere, said half sphere comprising a flat face that is planar with the polygon and the half sphere extending interior to the modeled object. Claim 37 refers to the polygon's free neighborhood comprising a material zone represented by a half circle, said half circle comprising a flat face that is aligned along the edge and the half circle extending interior to the modeled object. The definition used for the polygon's free neighborhood in Claim 37 appears to be in error and conflicts with the definition used in Claims 26 and 32. Should this be an edge's free neighborhood? These definitions conflict with specification Page 2, Para 3, "Free neighborhood is a material zone, represented by half sphere containing the material of the object and delimited by a triangle"; specification Page 7, Para 2, "Free neighborhood of a triangle is a material zone, represented by half sphere containing the material of the object and delimited by a plane of a triangle".

The "free neighborhood" for different geometric entities may differ depending on the particular entity. To prevent confusion, the term "free neighborhood" has been removed from the claims and appropriate clarifying language added.

6.4 The applicants have used inconsistent and incomplete definitions and descriptions of the free neighborhoods for the edges and polygons. They have attempted to explain them by distinguishing them for the three-dimensional and two-dimensional swept volumes in amendment filed on August 14, 2002. However, the descriptions provided in the amendment of

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August 14, 2002 are not available in the original specification for use by one of ordinary skill in the art.

The undersigned believes that removal of the term "free neighborhood" from the claims and the further explanations stated with respect to paragraph 5 of the Office Action, fully address paragraph 6.4 of the Office Action.

6.5 The specification states that the free neighborhood of a triangle is a material zone. The amendment of August 14, 2002 states that the free neighborhood of a polygon is a material zone. The question is, is the free neighborhood of an edge a material zone, for the two dimensional case? The concept of the material zone as explained in the specification and the amendment of August 14, 2002, being the free neighborhood and being on the surface of the swept volume is conceptually impossible and appears to be incorrect. The applicants have failed to provide proper explanation in the specification making it impossible for one of ordinary skill in the art to make and use the system.

The terms "material zone" and "free neighborhood" have been deleted from the claims and the claims amended to clarify the claimed invention. The undersigned believes that these amendments fully address paragraph 6.5 of the Office Action.

Rejections Under 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 25- 39, of the application are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8.1 These claims are rejected because they use the concept of free neighborhood directly or as claims dependent on independent claims that use the concept of free neighborhood. However, the specification does not contain the definition of the free neighborhood anywhere, making the claims indefinite.

The term "free neighborhood" has been deleted from the claims and appropriate clarify language has been added. Further explanation accompanies the undersigned's comments on paragraph 5 of the Office Action.

8.2 Claims 25, 31 and 3 5 refer to constructing a representation of the swept volume from the generated traces of motion of said subset of edges. The applicants' attention is requested to the fact that the swept volume cannot be represented from the traces of the motion of the subset of edges alone; the motion of the polygons joined at the edges is also required. So Claims 25, 31 and 35 are incomplete and indefinite.

Claims 25, 31, and 35 have been amended to incorporate additional recitations directed to computing swept volume based on the motion of the polygons joined at the edges.

8.3 Claim 36 refers to constructing a representation of the swept volume from the generated traces of motion of said subset of vertices. The applicants' attention is requested to the fact that the swept volume cannot be represented from the traces of the motion of the subset

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of vertices alone; the motion of the edges joined at the vertices is also required. So Claim 36 is incomplete and indefinite.

Claim 36 has been amended to incorporate additional recitations directed to computing swept volume based on the motion of the edges.

Indication of Allowable Subject Matter

9. Subject to rejections listed above, and based on the prior art located to date and made of record, Claims 25-39 do not appear to be taught or rendered obvious, and are indicated as allowable subject matter.

The undersigned is grateful for the Examiner's indication of allowable subject matter.

CONCLUSION

Claims 26, 29, 32, 37, and 39 have been canceled and claims 25, 27, 30-32, 33-36 have been amended. Claims 25, 27-28, 30-32, 33-36, and 38 are now pending and believed to be in condition for allowance. Applicant respectfully requests that all pending claims be allowed.

Please apply any credits or excess charges to our deposit account number 50-0521.

Respectfully submitted,

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